

Artificial Intelligence in Architecture and Art Education

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Abstract. This article is written in the context of two European cultures from two countries with different histories, both universities collaborating in the field of digital arts. The aim of the study is to provide clear methods for the use of digital tools in higher education for students of architecture and visual arts. To achieve this objective, ten tasks have been set and the results are presented in this paper.

The methods used in the study include observation, photofixation, Prototyping interior design with artificial intelligence, literature studies, modelling, surveys, and interpretation of their results through graph-analytical methods.

The authors present the positive and critical aspects of education: artificial intelligence is powerful and fast at processing huge amounts of data that humans should be able to process over an incomparably longer period, but it is poor at judging people and art. AI accurately processes billions of websites and resources to offer the best results for our search queries, and it has beaten the reigning champions in many intellectual games. But based on their own and others' research, the authors show how inaccurate AI is, for example in predicting whether individuals who have previously used AI in their artwork might achieve better results than if they had produced their own work using their own talent and personal experience. AI is no better than a simple guess, and yet AI is being used to determine people's futures. One of the experts discussed by the authors is Zweig, who introduces us to the basics of AI and provides a toolkit for designing AI systems. Finally, all the respondents explore the ethics of AI and how we can shape the process, prepared us for the biggest question about AI: where we should use it - and where we should not with a particular focus on the quality of education, developing young people's creative abilities, fostering critical thinking and responsible decision-making.

Keywords: Artificial Intelligence, Architecture and Art Education, Prototyping Interior Design with artificial

intelligence, an experiment using AI-generated images, critical thinking.

I. INTRODUCTION

This article presents the results of a new research and experiment organised among 17-18 year old students of creative industries professions on 21 February 2024 at the Riga Art and Media Technical School. The aim of the experiment was to evaluate how young people use AI tools and software to generate visual materials for a studio project for a small apartment. The experiment was a success and the methods used led to a number of important insights for both the participants and the organisers. The results are presented in the paper.

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II. RESEARCH METHODOLOGY

Interactive experiences during study are emphasised according to Salama, (2015, pp. 229 - 232) as learning in dialogue with the teacher, with digital tools, with peers and play an important role as a pedagogical tool. The studios serve as a repository of collective knowledge that encourages critical and constructive conversations. These exchanges reveal an implicit understanding of design teaching and learning [26]. A definition that sums up this kind of conversation is critical conversation. The working definition of critical conversations in this research are talks that aim to analyse, structure and evaluate a project through different perspectives in order to solve problems, suggest alternatives or make decisions [26].

The stages of the analytical part of the research [16] – [19], which according to Miles, Huberman and Saldaña

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(2014), and Merriam and Tisdell (2016), include initial analysis, abstraction, consolidation, and verification [15]. The analytical process involved a cyclical process of induction and deduction that lasted for one. An essential part of the interpretive analysis was writing down reflections and discussing them with peers [13]. Dialogue with the teacher, the professional who issues the design brief, is very important in the initial analysis. As a result of these discussions, the student gains insight into the object, the main requirements for designing with digital tools, the deliverables and evaluation criteria, the project deadlines. The next phase of the analytical process is the research, during which the student learns about the site and its design constraints, the environment, the building architecture, the building structures, and the civil engineering structures [2]-[3]. In the exploratory part, the student carries out surveys, notes, interviews, observations, sketching, analogue research and analysis. All the information obtained is summarised by the student in the form of notes and visual material in the project portfolio.

The notes created in each student's description of interior design, including his personal experience in design studies and peer work observation, were exported from MAXQDA, combined and re-analysed with all student notes in the description of each project's Work Folder, Design Studio Observation, and Interviews. After that, all the notes on each study project were collected in the project portfolio. The purpose of the notes was to interpret the data into new concepts in order to answer the questions of the study. Thus, the process of interpretation of the student at the stage of abstraction of data analysis was guided.

The insights that the student gained in the process of work were integrated into the conceptual framework. The process of perfecting the conceptual framework and developing the coding scheme and notes continued with the new data to saturation. The data were collected in the final version and provided new input to the study.

The coding categories were linked and rearranged as mind map charts to obtain new comprehension categories [4]. The new concepts that emerged from notes and links were combined with a conceptual framework to guide the categorization process. This marked the beginning of the last deductive phase of the analysis. As a result, students had to summarize the obtained data in a well-reviewed description, tables, graphs so that they could be entered into AI image and text generation tools. The analytical results of the interviews of teachers and students were analysed. The components for the analytical results were structured according to meaning; their in-depth analysis was followed by a reconstruction measure, which resulted in findings and claims.

According to Seale (1999), since qualitative research reflects several possibilities, positivity criteria for validity and reliability can be revised using the original criteria [16]. He recognizes the translated terms of reliability (internal validity), portability (generalizer), reliability (loyalty), affirmative ability (objectivity), and authenticity, put forward by Lincoln and Guba as a means

of determining the reliability of realistic exploration (Seale, 1999, pp. 45–46).

Reliability in this study was determined by triangulating (measuring and verifying) evidence, conducting a comparative analysis, clarifying the position of the researcher, and reporting deviant cases. The transparency of the research process [17], the triangulation and reflection of the coding process ensured reliability (Mason, 2018). Confirmation was demonstrated by triangulating information, methods and coding systems, spending significant time on the ground, maintaining a database and displaying audit trails of the analytical process (Patton, 2015) [18], [20].

Personal experience of students was also significant, which allowed approaching the analytical process in more detail. Portability, not generalization, was ensured by giving rich descriptions and highlighting the uniqueness of the case (Maxwell, 2013) [19], [22], working with AI tools, during the process of generating interior design. Ethical issues were addressed by ensuring the confidentiality of participants and maintaining the protocol during data collection.

In design research (Cotsaftis, 2023) and when thinking about ethics, indeed, more and more many researchers are trying to challenge the utilitarian view of nature as an unlimited resource for human activity [32]. Authors around the world do this by criticizing examples in the history of design that focus on human flourishing at the expense of planetary conditions (Fletcher, et al., 2019; St. Pierre, 2019), without thinking sustainably (Bratuškins & Treija, 2019), highlighting the reducing binary link between nature and culture outlined in sustainability discourses (Fletcher, 2017; Williams & Collet, 2021; Cotsaftis, 2023) [20], [22], [32]; studying efforts to reassess humanity's relationship with nature through biodesign (Sawa, 2016; Bratuškins & Treija, 2019) [6]; or again analysing the interdependence between organisms and Earth forces (Haraway & Endy, 2019) [7] – [11]. In addition, critical reflections on the biological approach to design and innovation have drawn attention to the risks associated with the strengthening of new colonial and capitalist thinking precisely in these design approaches. For example, the works look at how some practices maintain the Enlightenment's understanding of nature as a world beyond it in order to capitalize human civilization from it (Fisch, 2017; Goldstein & Johnson, 2015) [32], [34]. While other works focus on the concepts of *biopiracy* and *biocolonialism*, by which indigenous peoples' knowledge is both erased and profits from *biodesign* companies (Ginsberg & Chieza, 2018; Ginsberg et al., 2019) [32]. Through research to promote critical thinking, the suggested works have had a big impact on young architects and designers, incentivizing them to focus on more sustainable solutions in their projects.

III. EXPERIMENT AND INTERPRETATION OF DATA

In the design department at the Riga Art and Media Technical School (RMMT), young people from 16 to 20 years old study. The experiment involved 2nd year 23 of the 29 students "Fig. 1", whose works will be further

analysed. The aim of the experiment was to find out what artificial intelligence (AI) programmes young people could use in their study projects in the field of interior design, what would be the results obtained, the conclusions drawn, and how young people would collect the obtained data in order to use them in the study process.

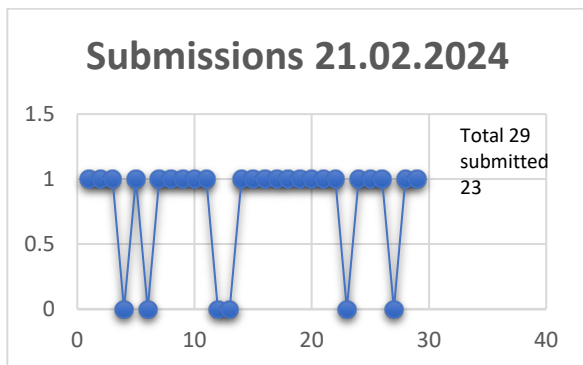


Fig.1. RMMT 2nd year students who participated in the experiment 21.02.2024

All participants in the experiment agreed to voluntarily participate in the process of generating images using various AI programs. Mainly programs such as:

- Midjourney (midjourney.com)
- DALL-E (openai.com)
- Adobe Firefly (adobe.com/lv/products/firefly.html)
- PixLR (pixlr.com)
- Fotor (fotor.com)
- Neuro-Holst (https://neuro-holst.ru/)
- Canva (canva.com)
- Imagine (imagine.art)

The participants of the experiment were given the task – to choose any program with the help of which to generate no less than 4 images for the interior of their studio type residential environment in such a way that it meets the requirements of the project, the artistic concept, the list of requirements and wishes of the client created in the project, the possibilities and requirements of the architecture and building structures of the object. Visualizations were to be performed within 4 academic hours and after the lesson the work had to be submitted in an aggregated form, with its comments on the process, conclusions about the results. Students initially had a lot of excitement and did not know which programs offered the free version, what the possible results would be. It could be observed that most of students (80%) switched to English in order to enter data into the programs as accurately as possible. The first results were received within minutes of "Fig.2, Fig.3" and this encouraged others to use the same programs (mainly Neuro-Holst was used by young people whose native language is Russian or Ukrainian), Latvian students used PixLR, Midjourney.

In both images, "Fig.2" and "Fig. 3", it can be observed that in the relatively realistic visualizations there

is a series of errors that could not occur if the visualizations were modelled with some design program that students use daily in their interior design projects, such as *ArchiCad*, *SketcUp*, or *Revit*.



Fig.2. Bedroom interior created by Sindy Jacobson with the help of PixLR AI tools.



Fig.3. Bathroom interior created by Sindy Jacobson with the help of PixLR AI tools.

Referring to the sources discussed above, after discussing the results with the students, it is concluded that the participants of the experiment shared two groups – one, whose participants wanted to incorporate more biophilic design into their works, use sustainable materials and make designs user-friendly, the other group members it was important to create a modern, luxury residential environment, made of expensive materials, without delving into the guidelines of the circular economy. At this age, young people pay great attention to fashion trends, colors, are less interested in well-being or the reuse of materials. In their conclusions, the majority of respondents (78%) acknowledged that AI can be used in

the process of creative studies as a tool for the rapid reflection of ideas but cannot rely on its quality. The students admitted that it was interesting to try different programs and find out what their capabilities are. Everyone had analysed the images obtained and used the critical thinking methods "Fig.4." to describe the results achieved.

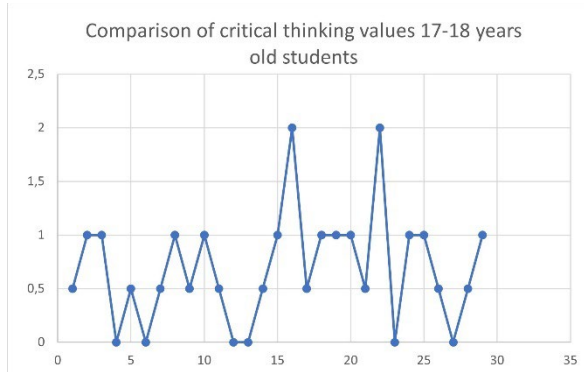


Fig.4. Critical thinking results of RMMT 2nd year students in the experiment 6 participants did not participate (0 point).

In "Fig. 4" it can be observed that only 2 young people (9%) out of 23 in this age group have very high observational and critical thinking abilities, 10 students (44%) have knowledge and interest in their chosen profession only at the initial stage, and 47% of students have critical thinking well developed. 6 students did not come to class due to various circumstances, mainly due to illness. They have a 0 point because the entries have not been submitted.



Fig.5. The interior of the sanitary room created by Anastasia Kaimachnikova with the help of Midjourney AI tools.

"Fig 5" shows that in the image generated by the AI, you can already read the much-needed water flush button above the toilet in the design of the built-in sanitary equipment, but the faucet, unfortunately, is located on the right side of the sink, not behind it and the bathtub is away from the wall, but inside it there are unnecessary several openings. The depth of the bathtub and the rest of the overall dimensions are not ergonomic. The same can be said about the arrangement of other sanitary facilities. Such mistakes would not have been made by man. Now let's look at another example.



Fig.6. The kitchen interior generated by Elizabeth Krukop with the help of PixLR AI tools.

For the most part, the conclusions were related to noticed errors and inaccuracies in the design of furniture and equipment. The design of light fixtures or their location, it was found that the images generated by AI contain unrealistic plants, errors in the symmetrical rhythmic arrangement of tiles, building structures or heating elements, as in the representation of fireplaces and stoves, but the sink may be depicted from the same material as kitchen cabinets "Fig 6".

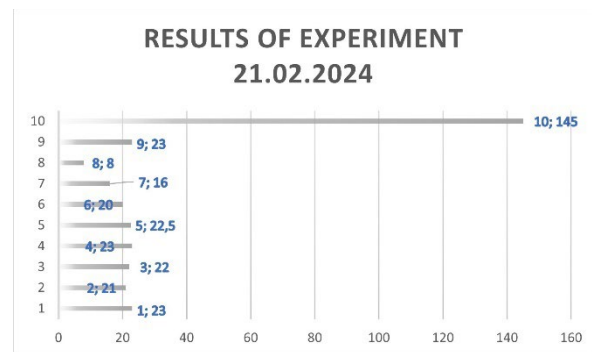


Fig.7. The results of the experiment of RMMT 2nd year students are inspired by 10 mandatory criteria.

The students were very enthusiastic about generating images and a total of 145 images of "Fig.7" were sent in and analysed, indicating a tendency to send at least one image more than was required. Several authors (26%) had submitted more than 7 images, carefully analysing them (criterion 10).

The remaining criteria were mostly (80%) fulfilled in full. Two criteria (7th - assessment of professional knowledge and 8th - creation of bibliographic content) were partially met. This indicates that it is important for students to acquire more profession-related expertise and skills, as well as to be attentive to respect copyright, even when using artificial intelligence. The language barrier, not just the lack of attention, could be an explanation for some young people who were even in text generation were used AI tools.

IV. RESULTS AND DISCUSSION

A. Critical thinking

The quality of the students' critical reflections and the number of conclusions they incorporated into their design process workbooks, varied. This fact also revealed how

highly they value critical thinking and how they intend to use it in their study projects [11] – [12]. In turn, the lecturers boosted the students' self-confidence in their learning by motivating them or pointing out changes in their study habits. Such stimulated meta learning processes can promote the internalisation of tacit knowledge, help in the communication process and contribute to the development of soft skills.

B. The analytical process

During the analytical process [13] – [15], students conducted initial analysis, abstraction, consolidation and verification of the project. During the analytical process, a cyclical process of induction and deduction took place, during which learners could prepare for the experiment. An essential part of the interpretive analysis was writing down reflections and discussing them with peers. By sharing their impressions during the experiment, the students gained confidence that they could prepare a project of a higher quality than AI. This was a breakthrough in their introspection and motivation. Many believed in their own abilities and later wrote in their self-analysis that they were very inspired by technology and appreciated how much they could do themselves, how precise the design had to be to avoid errors like those seen in the images generated by the AI.

C. Visual communication language

While the visual design processes in the creative industries are developed in detail during the study process, over the years the visual language becomes increasingly implicit. Spatial references to the volume of forms and materials, for example, can become more symbolic. This means that the visual language becomes more complex and coded.

The verbalisation of design arguments is always a point of contention amongst academics because drawings are the voice of the designer [7] – [8]. Developing a quality spatial composition is important in design, not only in the use of colour and material textures, which young people usually learn most quickly, but also in the coherence of spatiality, light, and mood. Using AI tools, many young people discovered unexpected compositions that inspired them immensely. Images and drawings, according by Goldschmidt, G., Hochman, H., & Dafni, I. (2010) [9], are seen as key factors to trigger discussion and explain the designer's thought process in an interior design project. Students are asked for arguments, explanations why they have made certain choices at the same time, according to the tutor, putting the validity of their ideas into words reveals students' critical thinking skills. Poggenpohl (2018) argues that concepts will require even more discussion and reasoning if they are radically new (p. 185) [4]. She adds that designers will need to defend their ideas through verbalisation in collaboration with people from other, non-design disciplines [4]. Design students need to be taught to participate in discussions with other disciplines Design students at RMMT are involved in freely participating in discussions with representatives of other disciplines on an equal basis, using a common verbal language, whether it be Latvian, English or Russian. Nowadays, young people in our country understand English better than their native language. There are completely different language barriers

than the generation of authors. Nowadays, augmented reality, virtual reality tools and artificial intelligence software are integrated into the visualisation of interior design projects De Paolis L, Chiarello S, Gatto C et al (2022) [33].

V. CONCLUSIONS

The information and technology tools that have been tested in this experiment are evolving rapidly in recent years and are increasingly being used to train a new generation of designers and architects.

Midjourney.com, Pixlr.com, Canva.com, Neuro-holst, imagine.art simplifies combined learning by allowing prospective students from art, design and architecture classes to work together on design projects and simulate real-world design scenarios, helping students understand how illustrations are used for announcement and influence in various creative projects and professions. This experience gives students the opportunity to develop their ideas, inspires and prepares them for future academic and professional careers.

By incorporating Canva.com as an artificial intelligence (AI) platform in creative projects, educators have the opportunity to create a modern and engaging environment for both students and clients, where future interior designers and architects can develop their visualisation skills. The visual nature of the platform encourages creativity, but it is also necessary to take into account the mistakes that AI still makes and to teach students to identify and correct them. AI platforms such as Midjourney and PixLR encourage the practice of visual language and provide students with valuable digital skills, visual communication skills for developing presentation material, which are necessary in today's globalised world.

Although the AI software visualises the design concept very quickly (within minutes), the experiment participants agreed that there are still many illogical errors in the visualisations. The programmes are not yet able to deal with symmetrical tile layouts, light fixtures and individual furniture details, as well as various rhythmically arranged interior elements. All participants indicated that it was an interesting challenge to use AI programmes, but they would certainly not do so for the final visualisation of the project. Currently, the programmes are useful for generating new ideas, testing quick results in visualisations, designing the work, but for project visualisations everyone would still use the proven design programmes, like *ArchiCad* and similar.

Many universities (Aalto University. (n.d.), The Institute for Ethical AI in Education (2021), The University of Adelaide (2023), University of Oulu, University of Tartu. (2023), Riga University of P. Stradiņš, and others whose contributions are not summarised in this article) have already developed and published guidelines for the methodological use of AI in academic work and pedagogical didactics. Most of these methods are for faster verbal and text retrieval, data processing, with less focus on the generation and use of visual data and quality images in creative professions.

In this article, the authors provide insights into the usefulness of using specific AI techniques to create visual

images. The recommendations are based on the authors' experience in early 2024. Understanding how fast technology is evolving, it is concluded that methods that are recommended today will be considered obsolete soon. AI should always be used responsibly, and students should be advised on the ethical use of AI tools, in compliance with the Copyright Act and other regulations. Where ethical considerations such as the risk of plagiarism and the authenticity of students' work come up for discussion, the need to balance the challenges of AI in the learning environment with the development of students' critical thinking and the demonstration of academic integrity should be emphasised.

The experiment presented here summarises the results generated by different AI programmes that have been used to solve students' critical thinking tasks and stimulate their creative thinking. Students reported that they were inspired to use new technologies and would like to enrich their experience of using new technologies in this way. From an educator's point of view, this experience also enhances the learning of technology in terms of creativity and some research skills.

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